R3885154

MODEL 2174A-610B

SELECTIVE VOLTMETER

FSN 6625-062-4228

RYCOM

instruments, inc.

SERIAL NO. 933 & 1072

REPLACEMENT PARTS - see MAINTENANCE, Parts Ordering.

Changes special to this unit _____

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TEXT ADDENDUM for 2174A-610B Selective Voltmeter (Spectrum Analyzer).

SPECIAL CONNECTORS: Three UG connectors have been added on the back of the chassis.
Their functions are as follows:
The connector marked IN parallels the front panel INPUT connector.
The connector marked IF is tied to the cathode of V6 providing a low impedance IF amplifier output.
The connector marked HT parallels the front panel HEADSET jack.
The SPEAKER-HEADSET switch transfers the audio output from the speaker to headset jack and connector or vice versa. When the audio output is connected to the speaker, this switch connects 680Ω across the headset winding of T8.

BFO1 and BFO2: Two positions BFO1 and BFO2 have been added to the MONITOR switch. BFO1 position connects a 504.750 KC crystal to the monitor oscillator. BFO2 position connects a 505.500 KC crystal to the monitor oscillator.

SELECTIVITY, 3 KC: The passband of the 3 KC crystal filter has been widened from approximately 2400 cps to 3900 cps.

A section "IF and Crystal Filter tuning instructions" has been added at the back of the manual.

CERTIFICATION

RYCOM Instruments Incorporated certifies that this instrument was thoroughly tested and inspected and found to meet its published specification when it was shipped from the factory.

WARRANTY AND ASSISTANCE

All RYCOM Instruments Inc. products are warranted against defects in material and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed below for the specified period. We will repair or replace products that prove to be defective during the warranty period. No other warranty is expressed or implied. We are not liable for consequential damages.

Exceptions to this warranty are dry batteries or Rechargeable batteries which are subject to original manufacturer's inspection and warranty.

This warranty is void if, after having received the instrument in good condition, it is subjected to abuse, unauthorized alteration or unauthorized repair.

Where it is necessary to return the instrument to the factory, furnish information to the nature of trouble encountered. Ship prepaid to:

RYCOM INSTRUMENTS, INC.
9351 East 59th Street
Raytown, Missouri 64133

Attention: Service Department

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Railway Communications Inc
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INSPECTION

This instrument has been thoroughly tested and inspected before shipment.

The instrument should be inspected for damage as soon as it is received. If no damage is apparent, test for operation according to operating instructions in this manual.

SUMMARY

The Selective Voltmeter is a highly selective instrument for making voltage measurements of frequencies from .3 to 400 kc, varying in level from -90 to +32 dbm (30 volts maximum without external attenuator). Zero dbm reference is 1 milliwatt of power (or .775 volts) in a 600Ω load. The input signal is attenuated to the proper value by the attenuator, amplified and demodulated to 500 kc by a shunt type demodulator and variable oscillator. This 500 kc signal passes through a sharp crystal filter, then is amplified and detected. The dc output is applied to a 200 microampere meter. The meter has dbm and voltage scales and is calibrated to indicate the signal level at the instrument's input connector.

A wide crystal filter or broad tuning may be selected for monitoring. In this use the 500 kc amplifier output is demodulated by a shunt type demodulator and crystal oscillator for upper or lower sidebands, by a conventional diode detector for AM signals, or by slope detection for FM signals. The monitor output is to a speaker or headset jack. An internal calibrating circuit is provided so calibration can be made or checked as desired.

DESCRIPTION

GENERAL

All symbols referred to in this text such as (V1) (X9) (R53) or capitalized such as CAL 1 LEV or METER are stamped on the chassis or front panel of the instrument and/or used in the schematic drawing.

The input circuit contains a condenser (C1) to block DC potentials, a transformer in the input of 3002 filter so that measurements can be made on balanced circuits, a 400 kilocycle lowpass filter (3002) and an attenuator. The input impedance and balance or unbalance is controlled by UNBAL-BAL switch (S1). The ATTENUATOR properly adjusts the input signal applied to V1 and has a CAL position used in calibrating the instrument. The isolation amplifier (V1) feeds a shunt type balanced demodulator (V2) whose balance is controlled by MOD BAL controls C & R. A variable frequency LC oscillator (1/2 V3) and phase inverter (1/2 V3) supplies carrier frequency for demodulation. This frequency is controlled by the main tuning condenser (C36), BAND SEL switch (S3) and a trimmer condenser (C83) CAL 2 TRIM. The 100 cps or 3 kc crystal filter (X1 through X4 & T1 or X5 through X8 & T2) or 10 kc broad coupling (C26 and 29) passes the lower

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DESCRIPTION

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The input circuit contains a condenser (C1) to block DC potentials, a transformer in the input of 300Ω filter so that measurements can be made on balanced circuits, a 600 kilocycle lowpass filter (300Ω) and an attenuator. The input impedance and balance or unbalance is controlled by UNBAL-BAL switch (S1). The ATTENUATOR properly adjusts the input signal applied to V1 and has a CAL position used in calibrating the instrument. The isolation amplifier (V1) feeds a shunt type balanced demodulator (V2) whose balance is controlled by MOD BAL control C 8 R. A variable frequency LC oscillator (1/2 V3) and phase inverter (1/2 V3) supplies carrier frequency for demodulation. This frequency is controlled by the main tuning condenser (C36), BAND SEL switch (S3) and a trimmer condenser (C83) CAL 2 TRIM. The 100 cps or 3 kc crystal filter (X1 through X4 & T1 or X5 through X8 & T2) or 10 kc broad coupling (C26 and 29) passes the lower

sideband of demodulation. The 500 kc IF amplifier (V4 & V5) feeds both the measure (V6, D3-4) and monitor (V8,9&10) sections of the instrument. The IF amplifier gain is adjusted by CAL 2 LEV (R37). The meter circuit amplifier (V6) feeds a series shunt type meter rectifier (D3 & D4) whose output indicates on a 200 microampere meter calibrated in dbm and volts.

The amplifier (V8) feeds a series type demodulator (D1,D2) for monitoring lower sideband (LSB) or upper sideband (USB) signals. The carrier for this demodulator is supplied by a crystal controlled oscillator (1/2 V9). For monitoring amplitude modulated signals or slope detection of FM signals, this oscillator is made inoperative and diode D2 removed thus the circuit operates as a conventional diode detector. The resulting audio signal passes through the RC filter (R40,C57,C58) and amplifier (1/2 V9,V10), to the speaker or a headset plugged into the HEADSET jack (J3). The audio output amplitude is controlled by the potentiometer MON LEV (R42).

An audio signal may be amplified by inserting it in the AUDIO IN jack (J2) (if provided) just ahead of the audio amplifier (1/2 V9 & V10).

A self-contained calibrate oscillator (1/2 V7) is coupled to a cathode follower (1/2 V7) whose output is adjusted by the potentiometer CAL 1 LEV (R55). Plate power is supplied to the calibrate oscillator only when the BAND SEL switch is in the CAL position, thus it is in operation only during calibration.

Plate power is furnished by a bridge type full wave silicon rectifier (SR1). A voltage regulator tube V11 stabilizes the plate supply to all circuits except the monitor section.

The filaments are 50 volts DC above ground (R5-8, C9-10), to prevent heater to cathode leakage and to lower 60 cps modulation which may occur in V1 and V2.

INPUT

An input impedance of 135Ω, 600Ω or bridging may be selected by the UNBAL-BAL switch S1. This switch also changes the input circuit from unbalanced to balanced on any impedance. The BRIDGE input impedance is approximately 10,000 ohms from 1 to 30 kc, gradually falling to approximately 5000 ohms at 400 kc.

An input impedance of 150 ohms instead of 135 ohms may be obtained by removing resistor R3.

Frequencies to be measured are connected to the INPUT connector (J1). Both sides of the connector are insulated from the front panel, thus isolating it from chassis ground during balanced measurements.

ATTENUATOR

The attenuator provides 0 to 100 db of attenuation for measuring signals between -68 and +32 dbm (full scale meter indication).

The CAL position is connected to the voltage divider of the calibrate oscillator output for calibrating the isolation and IF amplifiers.

FREQUENCY

The variable frequency oscillator (#3019), is varied from 500.3 to 900 kilocycles by BAND SELECTOR switch and the main tuning dial to measure frequencies of .3 to 400 kilocycles respectively as indicated on the frequency dial. For example, a signal of 1 kc is fed into the instrument. The BAND SELECTOR switch is set on A and frequency dial tuned to 1 kc. The v.f. oscillator is now oscillating at 501 kc and the lower sideband of demodulation is 500 kc which is the center frequency of the crystal filter. This is amplified by the IF and meter amplifiers and indicates on the meter, or is detected in the monitor section producing a tone in the speaker or headset.

Tuning for calibration (BAND SELECTOR on CAL) is separate from the main tuning dial and adjusted by the CAL 2 TRIM control. This greatly simplifies meter calibration and calibration checks if desired while using the instrument. Since the CAL 2 TRIM control remains in the tank circuit on all bands, it can be used as a frequency vernier when making measurements. This, however, temporarily disturbs the frequency calibration of the instrument. When making an internal calibration of the instrument, the v.f. oscillator frequency is automatically recalibrated at 530 kc by the CAL 2 TRIM control using the 30 kc calibrate oscillator frequency as a standard.

The trimmers C40,42,44,46,48 & 88 are used to set the frequency of each band (A,B,C,D,E&F). C38 is used to set the calibrate frequency tuning. These calibrations are made with CAL 2 TRIM (C83) at mid range.

DEMODULATOR BALANCE

When measuring frequencies below 1 kc, the demodulator must be balanced to prevent erroneous readings due to v.f. oscillator frequency passing through the crystal filter and being measured along with the desired signal.

The demodulator is balanced with the variable frequency oscillator at 500 kc (frequency dial at zero) so the carrier (oscillator frequency) will pass through the crystal filter (100 cps bandwidth) and indicate on the meter. C & R are adjusted for minimum meter indication thus a minimum carrier frequency (carrier leak) at the modulator output.

The two controls C MOD BAL R (C81,R25) control the balance of the demodulator (DEMOD, V2). The C control (C80) balances the capacity component and the R control (R24) balances the resistive component.

SELECTIVITY

The SELECTIVITY switch is used to select one of three filters at the demodulator output. The position marked 100~ selects a sharp crystal filter for measuring. The position marked 3 kc selects a filter of appropriate width for demodulating 3 or 4 kc single sideband voice channels. The position marked 10 kc selects a coupling network to the IF amplifier whose transformers determine the band width of this position. This position is used in monitoring amplitude modulated and frequency modulated voice channels or signals. The response curves are in the back of the book.

MONITOR

The control marked MONITOR LEVEL is an on-off switch (AC OFF) for the AC power to the instrument and the gain control of the audio amplifier of the monitor section. The USB position of the MONITOR switch connects a 501.47 kc crystal to the monitor oscillator (B F OSC, V9b) for demodulating upper sideband signals. The LSB position connects a 489.53 kc crystal to the oscillator for demodulating lower sideband signals. The AM position disconnects the plate power to the oscillator and disconnects diode D2 thus converting the series type demodulator to a diode detector.

METER

The METER switch (S5) controls the input to the meter circuit (V6,D3 & D4 and meter). The OFF position shorts the meter input terminals to prevent pinning the needle while monitoring weak signals. The ON position connects the IF amplifier output to the meter circuit for measuring and for the second step of calibration. The CAL 1 position connects the calibrate oscillator output to the meter for the first step of calibration.

CALIBRATION

BASIC CALIBRATION: Basic calibration adjusts a precision voltage divider (R57-R60 and attenuator CAL position) to give a correct meter indication, using an accurate external source as a standard. This adjustment is made at the factory. It can be checked and readjusted, (CAL 3) if necessary, as given in the maintenance section.

INTERNAL CALIBRATION: Internal calibration calibrates the isolation amplifier and IF amplifier (V4,V5) using the precision voltage divider as a standard. This calibration is made as a part of the normal operation of the instrument.

Internal calibration uses the self-contained calibrate oscillator and is accomplished in two steps. Detailed step-by-step procedure is given in the operating instructions. The first step consists of feeding the calibrate oscillator output direct to the meter

amplifier and adjusting the calibrate oscillator output (CAL 1 LEV) to give any desired meter indication (usually 0). The second step consists of feeding the calibrate oscillator output through the precision voltage divider (R57-R60 and attenuator CAL position), isolation amp (V1), IF amp (V4-V5) to the meter stage, and adjusting the IF amp gain (CAL 2 LEV) to give the same meter indication set in step 1. This sets the isolation and IF amplifier gain equal to the loss in the precision voltage divider.

Internal calibration also recalibrates the variable frequency oscillator frequency as noted in FREQUENCY paragraph.

OPERATING INSTRUCTIONS

GENERAL

Operation of the Selective Voltmeter is divided into two major functions, that of measuring signals as indicated by the meter and that of monitoring carrier and audio voice bands or signals.

All controls, signal input, audio input and output jacks, and power connections are on the front panel of the portable instrument. Input, output and power connections may be on the back of the rack mounted instrument.

The power required is 48 watts 50 to 400 cps, 115 volts. Connection is made to the instrument with the cord furnished in the receptacle (AC). The power switch is located on the MONITOR LEVEL control where the off position is indicated (AC OFF).

DEMODULATOR BALANCE

Balance the demodulator as follows with the input signal disconnected (for measuring frequency below 1 kc).

a. Switch positions.
   BAND SELECTOR on A
   SELECTIVITY on 100~
   MONITOR LEVEL on minimum
   FREQUENCY dial near 0
   METER on ON

b. Adjust MOD BAL controls C and R to obtain a minimum meter reading.
   NOTE: If meter reads off scale, adjust FREQUENCY dial up scale for full scale meter reading, adjust C and R for preliminary balance (minimum meter reading). Return FREQUENCY dial to zero frequency (maximum meter reading) and rebalance. Repeat if necessary. At final balance it should be possible to tune across 0 frequency with an on scale meter reading.

c. If a balance cannot be obtained within the limits (see note C1) of the C&R control on the front panel, adjust the coarse C&R balance controls (see note C2). Set the C&R front panel controls in mid-range and adjust C&R coarse controls until an on scale balance is obtained. Complete the balance with the front panel controls.
   Note C1: The MOD BAL C&R controls have ball planetary drives. R has a 10-turn control and C has a 4-turn control. The limits of rotation are indicated when the drive slips at one extreme of rotation.
   Note C2: Remove the unit from the case and locate the variable frequency oscillator assembly (#3019) under the chassis. Adjust the capacitor and potentiometer controls through the holes marked C&R.

The degree of balance needed is dependent on the selectivity of the crystal filter and the frequency measured.

The 100 cps crystal filter is down more than 20 db at 300 cps off and 60 db at 500 cps off, thus a 0 db balance will cause negligible error when measuring a 300 cps or higher tone.

A quick check is to tune in the desired signal, remove the input and observe the meter reading due to carrier. If it is less than an estimated -25 db, then any reading above -10 db will be affected less than .1 db. NOTE: Do not set the meter zero on 0 volts. The meter zero is used for meter tracking at -10 db on some units.

At low balance, a double peak or erratic meter fluctuations may be noted. These do not necessarily indicate trouble if the instrument performs satisfactorily when measuring a tone.

The tube used as V1 is critical in determining the degree of balance obtainable principally due to heater to cathode leakage. Select a 6BH6 tube or a 6661/6BH6 to give best balance.

INTERNAL CALIBRATION

Calibrate the instrument as follows for direct reading in dbm for the circuit impedances listed.

CAL 1

a. Switch positions.
   BAND SELECTOR to CAL, ATTENUATOR to CAL, METER to CAL 1
b. Adjust CAL 1 LEVEL to give zero on meter DB scale for a 600Ω circuit.
   For other circuit impedances adjust CAL 1 LEVEL to the following meter indications.
   (1) -6 for 150Ω circuit. (2) -6.5 db for 135Ω circuit.
   (3) -6.7 db for 130Ω circuit (4) -9 db for 75Ω circuit.
   (5) -9.2 db for 72Ω circuit

CAL 2

a. Switch positions.
   BAND SELECTOR to CAL METER to ON MONITOR to AM
   ATTENUATOR to CAL SELECTIVITY to 100~
b. Adjust CAL 2 TRIM to peak meter.
c. Adjust CAL 2 LEV to give zero on meter DB scale for ALL circuit impedances.

This completes the calibration and the instrument is ready for use.

INPUT CIRCUIT SELECTION

The input may be unbalanced or balanced for an input impedance of 135Ω, 600Ω, or bridging as selected by the UNBAL-BAL switch. The input jack on a standard unit takes a 3/4" spaced dual banana plug. Other input connector types are supplied when so ordered.

FREQUENCY SELECTION

Frequency selection is made by means of the BAND SELECTOR, FREQUENCY and SELECTIVITY controls. The frequency to be measured is tuned in by the large center knob and position A,B,C, etc., of the BAND SELECTOR switch.

The SELECTIVITY switch selects the crystal filter band width to be used. Use the 100 cycle position for precise measurements and the 3 kc and 10 kc position for monitoring. The 10 kc position may be used for measuring above 10 or 20 kc.

AMPLITUDE MEASUREMENT

Connect the signal to be measured to the INPUT JACK. (CAUTION: See overload paragraph).

a. Switch positions.
   BAND SELECTOR to desired band
   ATTENUATOR to proper level
   METER to ON
   SELECTIVITY to 100~
   MONITOR to AM (for precise measurements)
b. Adjust FREQUENCY dial to desired frequency and for maximum meter indication.
c. Add meter indication and attenuator position algebraically to obtain amplitude of signal being measured.

LOW FREQUENCY MEASUREMENTS

Measurements below 1 kc to about 300 cps require certain precautions. The demodulator must be balanced as given in the Demodulator Balance paragraph to prevent erroneous meter indication due to carrier leak.

The input impedance below 1 kc with the instrument on the 135Ω position increases to approximately 170Ω at 300 cps due to the impedance ratio of C1 to R2-R3. If 135Ω impedance is desired at low frequency, use the BRIDGE impedance position and an external 135Ω terminating resistor.

OVERLOAD

The amplifiers of this instrument overload before the meter movement is damaged on moderate overloads--however excessive or prolonged overloads should be avoided.

Amplitudes of +20 dbm or higher should not be left applied to the instrument for longer than a minute or two, since the input circuit may heat. If +20 dbm or higher amplitude is to be connected continuously, a suitable pad should be connected ahead of the instrument to reduce the level below +20 dbm.

LOW AMPLITUDE SIGNALS IN PRESENCE OF HIGH AMPLITUDE SIGNALS

Overloading is reduced by introducing attenuation to the input signals. Therefore when measuring a low level signal, when high levels are also present, the more accurate reading will be made when the attenuator step is selected to give a meter reading on the lower 10 db section of the meter scale. When measuring

circuits on which amplitudes are not approximately known, it is suggested that the entire spectrum be first scanned to determine the highest amplitude signals present. This will indicate the lowest level signals which may be accurately measured. When highest to lowest levels exceed 45 db, some inaccuracy due to overload or intermodulation may be suspected. When measuring harmonics of a single frequency input, accurate readings may be made 50 db or less for 2nd and 60 db or less for 3rd harmonics.

In any case, when a low level signal is being measured, if the attenuator switch is changed by 10 db and the meter reading also changes 10 db, the measurement can be considered accurate.

When many input signals are present, no simple rule can be followed, as the overload point is determined by the peak envelope of the combined signals which may vary with their amplitude and phase.

CARRIER MONITORING

The Selective Voltmeter may be used to monitor lower sideband (LSB), upper sideband (USB), amplitude modulated (AM) or frequency modulated (FM) signals. Use the 3 kc position of SELECTIVITY switch above 3 kc only and the 10 kc position above 10 kc only.

1. Upper and lower sideband monitoring.
   a. Connect the input connector to the circuit to be monitored.
   b. Switch positions.
      SELECTIVITY to 3 KC
      BAND SELECTOR switch & FREQUENCY dial to midband frequency of the sideband
      MONITOR switch to LSB or USB as required
      MONITOR LEVEL--adjust as needed

If the voice or signal from the speaker (or headset if used in HEADSET jack) is weak, turn the METER switch off and the ATTENUATOR down until the desired level is reached.

2. AM monitoring.

To monitor AM signals feed the signal in the INPUT connector, turn the selectivity to 3 kc or 10 kc, set the MONITOR switch to AM, tune the FREQUENCY dial to the carrier frequency and adjust the amplitude as for single sideband signals.

3. FM monitoring.

To monitor FM signals by slope detection, feed the signal in the INPUT connector, turn the SELECTIVITY switch to 10 kc, set the MONITOR switch to AM, adjust the frequency dial for best reception (one side of the selectivity curve) and adjust the amplitude as for single sideband signals.

AUDIO MONITORING (on units with AUDIO IN jack)

The audio section of the monitor circuit may be used as a voice frequency amplifier if desired by inserting the signal in the AUDIO IN jack. The output amplitude is controlled by the MONITOR LEVEL control.

MAINTENANCE

GENERAL

Most of the components used in the construction of RYCOM instruments are standard parts obtainable from local suppliers. Precision components may be purchased from the manufacturer. Special items may not be readily available from the manufacturer. All replacement parts are available from RYCOM.

For various reasons, changes will occasionally appear in the instruction book text, parts list and drawings. Continued effort is being made to improve circuitry and use better components. During the test procedure, individual adjustments are made to obtain optimum operation. Parts procurement difficulties occasionally require substitution of different but equivalent parts.

Routine maintenance involves replacement of tubes, fuse and pilot lights.

The frequency dial lights are accessible from the front by removing the frequency TUNING knob and black dial cover. When replacing the frequency knob, depress the compression spring washer to give sufficient torque for the desired feel in rotating the knob.

To remove the instrument from the case for maintenance, remove only the screws around the edge of the front panel.

PARTS ORDERING

When ordering parts be sure to specify the instrument serial number as well as the instrument model number and individual part number and symbol. This will insure receiving the correct replacement parts with a minimum of delay.

BASIC AMPLITUDE CALIBRATION

Tube replacement or aging may cause some error in meter indication which is not expected to be more than $\pm\frac{1}{2}$ db. This can be corrected by basic recalibration of the instrument as discussed in "Calibration" paragraph of the description and given in step form below.

1st step

a. Connect an external signal of about 45 kc of 0 dbm amplitude to the input connector (NOTE: use a precision meter to determine the 0 dbm amplitude).

b. Switch positions.

ATTENUATOR on 0	MONITOR on AM
METER on ON	BAND SELECTOR on B
SELECTIVITY on 100~	FREQUENCY dial to give peak indication on meter

c. Adjust CAL 2 LEV to give 0 on meter.

2nd step
a. CAUTION do not change CAL 2 LEV.
b. Switch positions.
METER on CAL 1 BAND SELECTOR on CAL
c. Adjust CAL 1 LEV to give 0 on meter.

3rd step
a. CAUTION do not change CAL 1 LEV or CAL 2 LEV.
b. Switch positions.
METER on ON MONITOR on AM
ATTENUATOR on CAL BAND SELECTOR on CAL
SELECTIVITY on 100~
c. Adjust CAL 2 TRIM for peak meter indication.
d. Adjust CAL 3 control located on top of the chassis behind the meter to give zero on the meter.

Repeat steps 2 & 3 since controls interreact somewhat.

METER TRACKING

On some units the zero adjust control is used for tracking the meter at -10 db on the scale.

To check or reset meter tracking adjust the unit to measure a frequency at 0 on the meter. Turn the attenuator up 10 db to read -10 on the meter. Adjust meter zero screw for -10 if needed. Turn attenuator down 10 db and readjust CAL 2 LEV for 0. Recheck -10.

FREQUENCY CALIBRATION

Frequency recalibration is made each time CAL 2 TRIM control is adjusted for peak meter indication during calibration, however if the frequency tuning drifts more than 500 cps it may be desirable to recalibrate the bands that are off and all lower frequency bands. If CAL 2 TRIM gives a peak indication at either extreme of rotation (when planetary drive slips), the oscillator in CAL position has drifted out of the range of the control and the CAL position should be recalibrated.

An accurate 10 to 400 kc oscillator, or oscillator and counter will be required to recalibrate the frequency dial (variable frequency osc).

Remove the case, turn on the power and allow the instrument to warm up for 20 minutes. Connect the external oscillator to the INPUT jack. Set the CAL 2 TRIM control two turns from either limit. Set the attenuator control to level used, BAND SEL and frequency dial to position indicated in the chart below. Adjust the trimmer indicated in the chart to obtain a peak meter indication.

ATTENUATOR	BAND SELECTOR	FREQ DIAL	ADJUST TRIMMER
Level used	F	350 kc	F (in #3019 osc)
"	E	230 kc	E (on top of chassis)
"	D	160 kc	D "
"	C	100 kc	C "
"	B	50 kc	B "
"	A	10 kc	A "
CAL	CAL	--	CAL "

The capacitors in the main oscillator are accumulatively added to the circuit as the BAND SEL switch is rotated from F to CAL, thus frequency calibration must be made in the order listed above.

IF STAGE RETUNING

In the event CAL 2 LEV amplitude cannot be turned high enough to calibrate the instrument, tube replacement, retuning the IF stage transformers, or retuning the crystal filters will be necessary.

Connect a signal of about 50 kc to the INPUT jack. Tune in the signal and adjust front panel controls for maximum meter indication with SELECTIVITY switch on 100 cps. Rotate the top and bottom slugs of T4, then T5 for maximum meter indication. Do not rotate T3 slugs. See also the "IF and Crystal Filter Tuning" section in this manual.

CRYSTAL FILTER RETUNING

Crystal filter transformers are T1 and T2. T3 is adjusted during the crystal filter retuning.

See the "IF and Crystal Filter Tuning" section in this manual for the tuning procedure.

TROUBLESHOOTING

Before attempting to troubleshoot the Selective Voltmeter, study DESCRIPTION, pages 1-5. Proceed as follows:

a. Check for low quality or non-existent input signal.

b. Check input and output connections.

c. Measure filament voltage (6.3 VAC) between the filament output wires of the Power Transformer (T9, green leads). Note: Each side of the filament line is 50 volts DC above ground.

d. Observe all tubes to insure filaments are operating (V11 should glow purple).

e. Localize malfunctioning circuits by using "Troubleshooting Chart" in paragraph i.

f. Check and replace tubes in malfunctioning circuits as required. If this fails to remedy the malfunction measure voltages as given in the "Voltage Chart" at the end of this section.

g. If a tube or component is replaced in the Calibrate Osc, Osc-Demod, 500 KC IF amplifier or meter circuit, check the alignment as given in the maintenance section, pages 10-12.

h. Test equipment.

VTVM	- Triplett 850 or equivalent Input impedance: 1 megohm or greater Voltage range : 0 to 250V DC or higher
AC-VTVM	- Hewlett-Packard 400L or equivalent Input impedance: 10 megohm, shunted by 25 uuf, Input level range: -70 to +30 db Frequency range: .3 to 400 KC
Signal Gen.	- Measurements 65-B or equivalent Frequency range: 300 cps to 400 KC
Counter	- Beckman 7170 eput meter or 1 megacycle meter. Range: 0 - 1 megacycle or more.

i. Perform the circuit tests on the following page in sequence. If the Selective Voltmeter does not respond properly to the test for a particular group of circuits, a circuit of the group is at fault. (See Block Diagram and Schematic to localize trouble.)

Circuit Being Tested	Tests
1. Power Supply 105 VDC regulated.	DC voltage at V11 pin 5 -- 101 to 114V. AC ripple V11 pin 5 -- less than 002V.
2. Input circuit, Oscillator Demodulator, IF Amplifier, Meter circuit.	Set SELECTIVITY to 100 cps. Feed a 45 KC signal at 0 dbm (.78 volts) into the INPUT JACK, J1. Tune receiver to input signal with ATTENUATOR set to 0 db. Meter should read 0 db by adjusting CAL 2 LEV. If meter does not respond rotate SELECTIVITY to 3 KC, then 10 KC (see test 4). If meter still does not respond proceed to test 6.
3. Calibrate Osc.	Place METER switch in CAL 1 and BAND SELECTOR in CAL. Meter should read 0 db by adjusting CAL 1 LEV. Frequency measured at V7 pin 8 should be 28 to 31 KC and the level should be approximately .9V (CAL 1 CCW) measured with AC-VTVM.
4. 100~, 3 KC and 10 KC Filter Comparison test.	Place METER switch in ON, ATTENUATOR in CAL and SELECTIVITY in 100~. Peak meter indication by adjusting CAL 2 TRIM. Switch SELECTIVITY to 3 KC and 10 KC. Meter indication should not change by more than ± 2 db. If meter does not respond in one or 2 positions check these filter circuits.
5. Audio Amplifier (V9a, V10) and Demodulator (V9b)	With Selective Voltmeter in calibrate as described in the filter test above, MONITOR level 50% rotation. MONITOR switch LSB and USB a audio tone should be heard. MONITOR switch in AM, noise should be heard.
6. IF Amplifier (V4, V5,6) and Meter circuit.	Place a 47 ohm resistor from Pin 1 of V4 to ground. Connect a signal generator across the 47 ohm resistor. Tune signal generator to 500 KC and peak Selective Voltmeter reading at 0 db. The output of the signal generator should be between 160 and 250 uv.
7. Input Circuit.	Set S1 to BRIDGE and ATTENUATOR to -70 db. Feed 0 db at any frequency from .3 to 400 KC into J1. The level at V1 pin 1 measured with an AC-VTVM should be approximately -6 db.
8. Var. Freq. Osc. (V3) and Demodulator (V2)	Turn BAND SELECTOR to B and frequency dial to 50. With an AC-VTVM with minimum capacity lead measure the voltage at V2 pin 5 and 7. It should be 1 to 3 volts at 550 KC not necessarily the same on both pins. Measure the frequency at V2 pin 5 or 7. It should be 550 $\pm$ 2.0 KC. Check frequency of other bands using following formula: Osc. Freq. = 500 KC plus dial setting. Also see page 3, FREQUENCY.

Voltage Chart
(Use VTVM such as Triplett 850)

Tube Sym.	Pin Number								
	1	2	3	4	5	6	7	8	9
V1	0	.965	51	51	60	66	0	-	-
V2	.5	.5	51	51	2.05	0	-2.05	-	-
V3	68	0	4.7	51	51	76	-5.95	0	51
V4	0	1.75	51	51	100	100	0	-	-
V5	0	5	51	51	90	90	0	-	-
V6	0	1	51	51	55	62	0	-	-
V7	79	-10.5	0	51	51	79	0	3.85	51
V8	0	2.65	51	51	142	142	0	-	-
V9	76	0	3.2	51	51	145	66	71	51
V10	0	17.9	51	51	235	241	0	-	-
V11	105	0	-	-	105	-	-	-	-

Notes:

1. All voltages positive DC to ground unless otherwise noted.

2. Control settings
   BAND SELECTOR - CAL
   MONITOR - LSB
   ATTENUATOR - +30
   METER - ON
   CAL 2 LEV - normal setting (no signal input)

3. 6.3 VAC should appear between:
   Pin 3 and 4 on V1, V2, V4, V5, V6, V8 and V10.
   Pin 4, 5 and 9 on V3, V7, V9.

IF and CRYSTAL FILTER TUNING

I. THEORY OF CRYSTAL FILTER OPERATION

IF and crystal filter tuning requires special precautions and equipment, thus this complete section is devoted to it. Note particularly paragraph II C before making any adjustment.

The circuit of Figure 1 is the basic form of the crystal filters used in the 2174A Series (filter assy #3014).

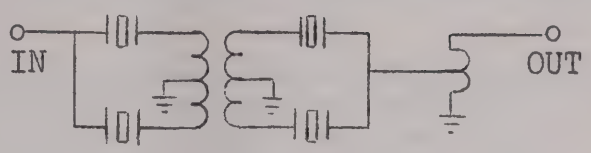


Figure 1. Basic Crystal Filter circuit used in the 2174A.

This filter is composed of two half-lattice crystal filter sections. The bandwidth of this type filter is determined by the frequency separation of the crystals used in each section of the filter. The crystals used in the same section are different but the crystals of the two sections are identical.

To allow this type of filter to be tuned for maximum passband flatness, the tuning of the two section terminations must be adjustable for impedance matching purposes. This is accomplished by RF transformers which are inductively tuned.

In order to adjust the fallbacks of the crystal filters as low as possible, trimmers are placed across all the crystals. Figure 2 indicates various terms used in describing the filters. Also on Figure 2 is a typical response of a wide 2174A crystal filter and the IF amplifier response curve. The total response of the wide filter is determined by the combinations of the crystal filter response characteristic and the IF amplifier response characteristic.

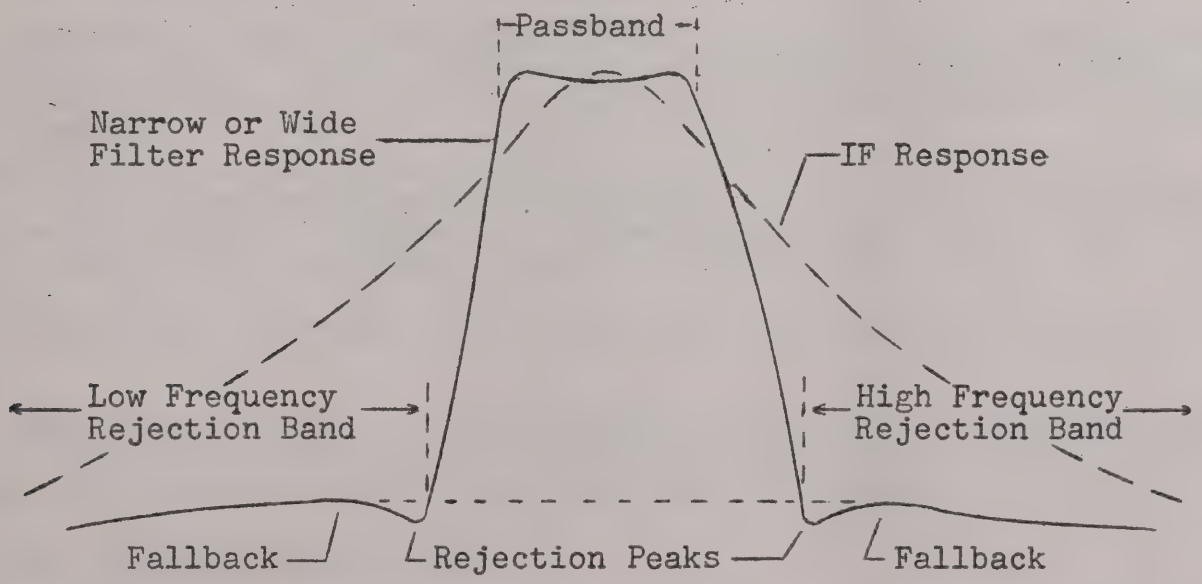


Figure 2. Crystal Filter Terms.

II. PRECAUTIONS

The following items are of general nature and pertain to trouble locations and/or tuning.

A. All transformers are critical coupled or less than critical coupled thus special procedures required for overcoupled transformers are not necessary. The slugs in all transformers should be tuned to their outermost tuning point. Tune top and bottom of all transformers except tune the top only of T3.

B. In general, the controls on the 2174A front panel will be set as for measuring signal applied to the input connector as given in the instruction manual.
Throughout these instructions 50 KC is used as a center frequency. This is merely a convenient frequency to use. Any frequency from 20 KC to 400 KC is satisfactory.

C. Inasmuch as crystal filter tuning is fairly difficult, it is most important that trouble be traced to the crystal filters before tuning is attempted. Retuning of crystal filters should not be attempted without using sweep "set up" given in paragraph III. If the meter amplitude is low in one or two, but not all three selectivity positions, the trouble quite likely is in the crystal filter (or 10 KC coupling C26-29) of low amplitude. If the meter amplitude is low in all three selectivity positions, the trouble quite likely is in a common circuit outside the crystal filter can and T3 circuit.

D. If the unit has been detuned by turning trimmers or trimmer replacement, then preset all so affected trimmers in mid-position. If the unit has become detuned due to aging only, all trimmers should be left as is for the preliminary setting.

E. C16 and C25 match the output of the narrow and wide crystal filters respectively to T3. Tuning of these three components thus is a part of tuning the two filters. T3 is also part of the IF and is used to shift the IF passband.
Adjustment of these three is roughly as follows.
Tune T3 (top) to center IF over wide crystal filter (3 KC) and C25 for amplitude of passband. Adjust C16 for amplitude and shape of the top of narrow crystal filter passband to match it to T3.

F. In tuning, the signal level should be kept below the overload point.

G. When tuning the IF, observe display on the scope and rotate MONITOR switch to LSB, then USB, and note marker on the IF curve. These may be used as convenient markers for centering the IF curve about 500 KC.

III. TEST EQUIPMENT REQUIREMENTS

A. Test equipment for observing response display on an oscilloscope.

1. A sweep frequency generator with mechanical or electronic sweep, 10 to 500 KC center frequency, .5 to 30 KC sweep width, 1 volt output amplitude. (Lower generator outputs may be used, however, the ability to observe the rejection bands will be limited accordingly).

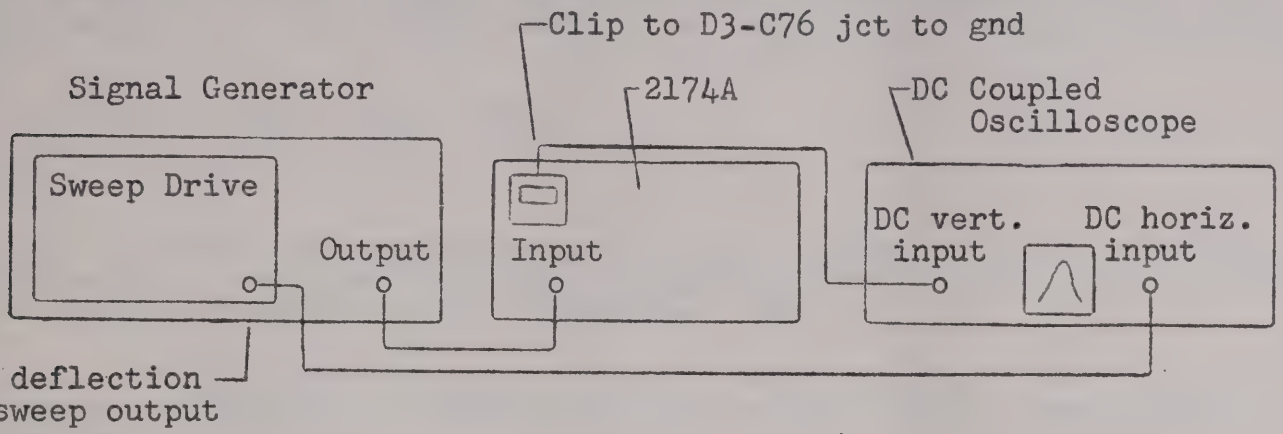


Figure 3.
Sweep Generator and Oscilloscope Connections.

2. An oscilloscope with DC horizontal and vertical inputs and a long persistence screen.

3. Connect equipment as given in Figure 3. Tune 2174A to center frequency used, turn METER switch to OFF, and CAL 2 mid-range or lower. Adjust generator frequency, deviation and level (about 0 DB for tuned unit) to give desired display on oscilloscope. To observe passband set Selective Voltmeter ATTN on 0 for a tuned unit. To observe the rejection band rotate attenuator to level of the rejection band. Figure 4 shows a typical display for the 50 or 100 cycle filter for passband and rejection band. Displays for other filters should be similar to the passband or rejection band portion of Figure 8.

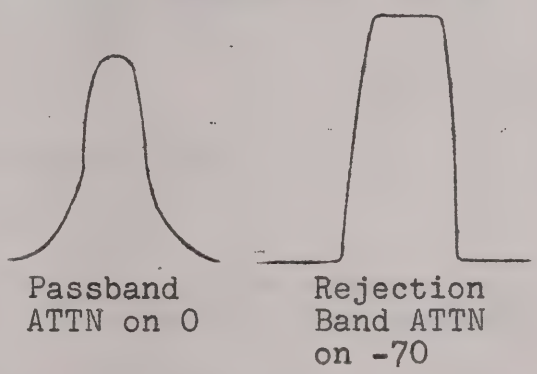


Figure 4. Typical display of 50 or 100 ~ filter on the scope.

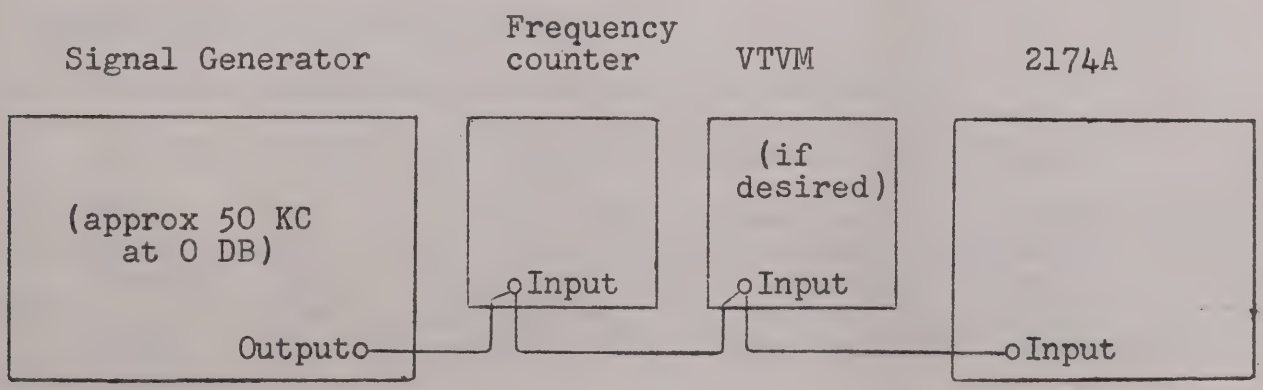


Figure 5. Equipment Connections for Response Measurements.

B. TEST EQUIPMENT FOR RESPONSE MEASUREMENT.

Connect a signal generator and electronic counter to the 2174A as given in Figure 5. Set Selective Voltmeter controls as given in AMPLITUDE MEASUREMENT paragraph of the OPERATING INSTRUCTIONS in equipment manual. Set signal generator frequency to 50 KC at an output level of approximately 0 DB.

IV. IF AND CRYSTAL FILTER TUNING.

A. IF Tuning.

1. Connect test equipment as given in paragraph III A, stop the sweep frequency and turn Selective Voltmeter METER to ON. (IF sweep can not be stopped, use equipment in paragraph III B).

2. Set SELECTIVITY knob counterclockwise (narrow filter). Set signal generator frequency at 50 KC and 0 DB output level. Tune 2174A for maximum meter indication.

3. Tune T4, T5 for maximum meter indication.

B. T6 Tuning.

Use equipment, etc., of A1 and A2 above. Tune T6 for maximum audio tone with MONITOR on LSB or USB. This is sole tuning of T6.

C. Wide Crystal Filter Tuning.

1. Connect test equipment as given in paragraph III A.

2. Set SELECTIVITY knob to 3 KC position.

3a. Rough tuning: adjust C18, T2, C25 and T3 (top) for maximum output consistent with fairly good passband shape. See Figure 7 for component location.

b. Fallback tuning: adjust C20 and C24 so fallbacks are below 90 DB and bandwidth at 60 DB down is sufficiently narrow (see Figure 6).

c. Passband tuning: with SELECTIVITY on 3 KC adjust C18, T2, C25 so the passband region is flat as possible. Rotate SELECTIVITY switch to 10 KC and adjust T3 top and T4 for rounded shape centered over the wide crystal filter. Repeat tuning with SELECTIVITY in 3 KC and 10 KC as required.

D. Narrow Crystal Filter Tuning.

1. Connect test equipment as given in III A.

2. Set SELECTIVITY knob counterclockwise (narrow filter).

3. First. Adjust T1 and C16 for maximum output consistent with fairly rounded passband. See Figure 7 for component locations.

Second. Adjust C11 and C15 so fallbacks are below 90 DB and bandwidth at 60 DB down is sufficiently narrow (see Figure 6).

Third. Adjust T1 and C16 for rounded top with no ripple in the top or skirts.

E. 10 KC Amplitude.

1. Connect equipment as in IV, A, 1.

2. Set SELECTIVITY knob on narrow filter and adjust as for measuring a signal. (See AMPLITUDE MEASUREMENT in instruction manual). Note indication on the meter. Set SELECTIVITY knob on 10 KC. Adjust tuning knob for maximum meter indication then adjust C26 to give a signal equal to the noted meter indication (i.e., set 10 KC level equal to narrow filter level).

F. WIDE FILTER AMPLITUDE

Normally no attempt is made to set this amplitude equal to the narrow filter or 10 KC. It may vary several DB.

V. IF & CRYSTAL FILTER RESPONSE MEASUREMENT

A. Connect test equipment as given in III B.

B. Set SELECTIVITY knob to position of filter being measured.

C. Adjust signal generator frequency to peak the 2174A meter indication and adjust level to give 0 on the Selective Voltmeter meter.

D. To obtain response curve vary the signal generator frequency and note levels as indicated on the meter and attenuator. Do not retune the 2174A frequency dial. Figure 8 gives typical responses.

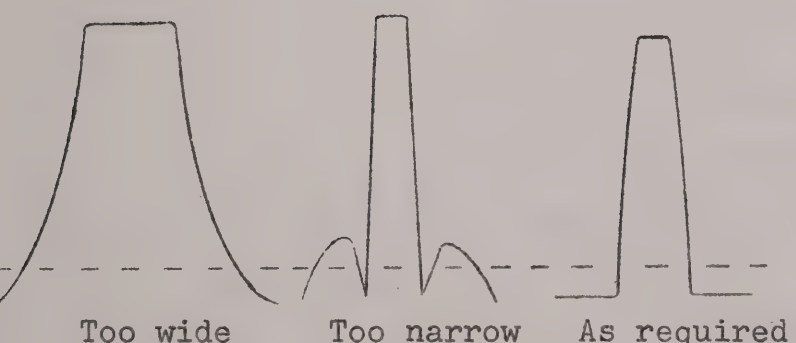


Figure 6. Rejection Band Adjustment of C11 & 15 or C20 & 24.

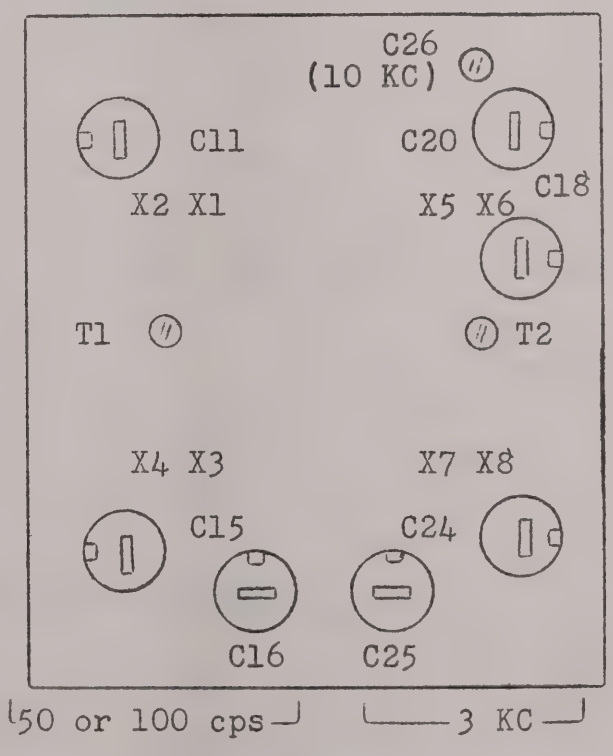
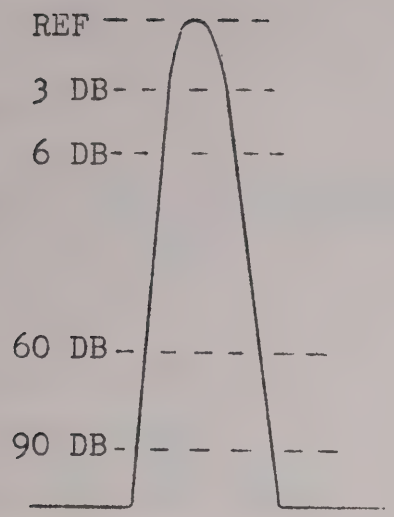


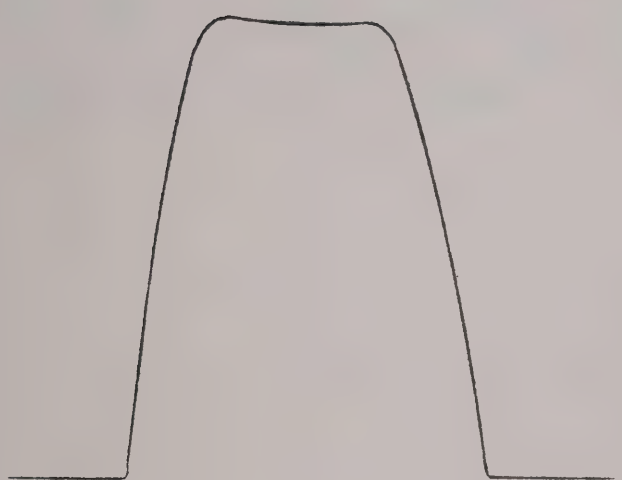
Figure 7. Adjustable Components Location.



SELECTIVITY positions: 50~, 70~ or 100~

FILTER	50 ~	70 ~	100 ~
	BANDWIDTH		
3 DB	35-50 ~	60-70 ~	80-100 ~
6 DB	70-80 ~	80-110 ~	110-150 ~
60 DB	350-500 ~	600-700 ~	800-1000 ~
F.B.	90	90	90
	CRYSTAL FREQUENCY		
X1, X3	499,975 ~	499,965 ~	499,045 ~
X2, X4	500,025 ~	500,045 ~	500,065 ~

Figure 8a. Narrow Crystal Filter Responses.

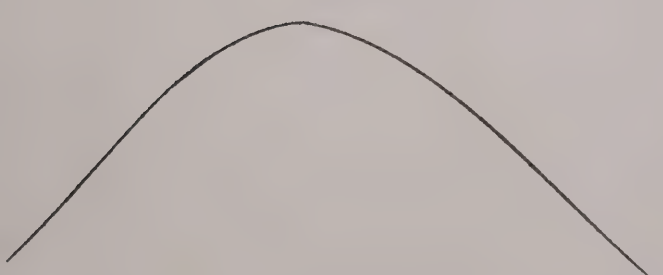


SELECTIVITY position: 3 KC

FILTER	2.2 KC*	2.4 KC	3.9 KC
ripple	.5-3 DB	0-2 DB	0-2 DB
3 DB	2050-2250 ~	2250-2550 ~	3700-4000 ~
6 DB	2300-2500 ~	2750-2950 ~	4000-4400 ~
45 DB	3950-4350 ~	-	-
60 DB	-	7050-9000 ~	7200-9000 ~
F.B.	50 DB	90 DB	90 DB
X5, X6	499,100 ~	499,100 ~	
X7, X8	500,900 ~	500,900 ~	-
X5, X8	-	-	498,530 ~
X6, X7			501,470 ~

*Without C18, C19 & L5.

Figure 8b. Wide Crystal Filter Responses.



SELECTIVITY position: 10 KC

	IF RESPONSE
3 DB	3800-5000 ~
6 DB	5200-6400 ~
45 DB	21000-24000 ~

Figure 8c. IF Response.

PARTS LIST

GENERAL

When ordering parts, always include:
1. Name, Model and Serial Number of the Instrument.
2. Circuit symbol.
3. Part number.
4. Description.

Order parts from

RYCOM INSTRUMENTS
9351 E. 59th Street
Raytown Missouri 64133

Phone 816-353-2100

This parts list applies to units with serial numbers above 735. Certain parts have been changed. The approximate serial number of the change is noted with an indication as to the interchangeability of the parts before and after the change.

This parts list may be used for units with serial numbers below 735 with the following exceptions. Symbol AT part number is SPEC-7355 manufactured by Daven Co., and is not interchangeable. Some other components have been changed, however the components as listed herein may be used.

SYMBOLS USED IN PARTS LIST

MANUFACTURERS

A	Alden Products Company
B	All Star Products Inc
C	Allen-Bradley Company
D	Bussmann Mfg Company
E	General Instruments
F	C.T.S. Corporation
G	Cletron Inc
H	E.F. Johnson Company
I	Electra Mfg Company or Kidco Inc
J	Electro Motive Mfg Company
K	Electron Products Company (Marshall Ind)
L	Erie Technological Products Inc
M	Good-All Mfg Company
N	International Rectifier Corp
O	James Knights Company
P	Ohmite Mfg Company
Q	Pace Electrical Instrument Co
R	RYCOM Inst (Railway Communications Inc)
S	Sherold Crystal Corporation
T	Stanwyck Winding Company
U	Switchcraft Inc
V	Sylvania Electric Products Inc
W	Transformer Technicians Inc
X	Wilco Corporation
AA	Arrow-Hart-Hageman
AB	Belden Mfg Company
AC	Grigsby Co Inc
AD	Hughes Corp
AE	Kulka
AF	Motorola
AG	Nytronics
AH	Amphenol
AI	Sealectro
AJ	Chicago Miniature Lamp
AK	Utah Radio Products
AL	Centralab
AM	Oak Mfg Company
AO	Semicon
MIL	Military type number

DESCRIPTIONS

A	Linear taper
CER	Ceramic
COMP	Composition
DC	Deposited carbon
DISC	Disc ceramic
ELEC	Electrolytic
FXD	Fixed
GMV	Guaranteed minimum value
HT	High torque
MP	Metalized paper
MYL	Mylar
NPO	Zero temperature coefficient
N750	Negative 750 parts per million per degree Centigrade (N80, N500 similar)
PLAS	Plastic
PM	Permanent magnet
S	Shaft (meas from end of bushing)
SD	Screwdriver shaft
WW	Wire wound
SM	Silver mica
VAR	Variable

Notes:

1. C84c normally is 47 uuf. It may be 33 to 68 uuf to give correct frequency tracking.
2. Components not common to both models are indicated as follows:

*Selective Voltmeter Model 2174A-610B only

**Selective Voltmeter Model 2174A-610C only

SYMBOL	NAME & DESCRIPTION	FEDERAL STOCK NO	MFG PART NO	MFG
	Selective Voltmeter (Spectrum Analyzer)	6625-062-4228	2174A-610B	R
	Selective Voltmeter (Spectrum Analyzer)	6625-089-6834	2174A-610C	R
AC	CABLE ASSEMBLY, ac power	2995-842-0721	17460S	AB
AT	RESISTOR, step by step: 100 db 10 steps + CAL	5905-063-7761	RY-7355	R
C1	CAP, FXD, MP: 5 uf ±20% 100 wvdc	5910-854-3351	W1-505	K
C2,5,35,37	CAP, FXD, CER: .01 uf GMV 600 wvdc	5910-854-3342	DA048-248K	AL
50-54,56	or .01 uf GMV 500 wvdc		0811000Z5U00103P	L
59,60,66	(C5 above used before Ser No. 1630 and for			
72,73,75,76	1651-1700)			
C5	CAP, FXD, CER: .01 uf ±20% 200 wvdc		0805030Z5U00103M	L
	(used after Ser No. 1700, interchangeable)			
C3	CAP, FXD, ELEC: 40 40 20 uf 450-450-25 wvdc	5910-854-3349	TMT3625	E
C4a,69	CAP, FXD, SM: 910 uuf ± 5% 500 wvdc	5910-850-9669	DM19E911J	J
C4b	CAP, VAR, MICA: 80-480 uuf	5910-552-0018	466	J
C6,9,10,55	CAP, FXD, MYL: .1 uf ±20% 200 wvdc	5910-854-3352	1732000104M	L
71,74,78				
C7	CAP, FXD, MP: .22 uf ±20% 400 wvdc	5910-854-3350	W4-224	K
C8,12,17,21	CAP, FXD, CER: NPO 3.3 uuf ±.25 600 wvdc	5910-854-3345	TB60339CC0J	AL
	or NPO 3.3 uuf ±.25 500 wvdc		0831000C0G0339C	L
C11,15,20,24	CAP, VAR, CER: 1.5-7 uuf NPO 350 wvdc	5910-870-5814	0557051C0P010R	L
C16,18,25	CAP, VAR, CER: 8-50 uuf N750 350 wvdc	5910-648-8455	0557051U2P034R	L
	(C18 used before Ser No. 1345)			
C18	CAP, VAR, CER: 9-50 uuf N750 350 wvdc		3192000U2P047R	L
	(used after Ser No. 1345, interchangeable)			
C19	CAP, FXD, SM: 300 uuf ± 5% 500 wvdc	5910-617-4230	DM15E301J	J
C26	CAP, VAR PLAS: .5-5 uuf 500 wvdc	5910-854-3358	5320013R	L
C29,65,C84c*	CAP, FXD, SM: 47 uuf ± 5% 500 wvdc	5910-691-0202	DM15E470J	J
C31,32,86	CAP, FXD, SM: 1000 uuf ± 5% 500 wvdc	5910-691-0333	DM19E102J	J
C33	CAP, FXD, SM: 200 uuf ± 5% 500 wvdc	5910-850-9322	DM15E201J	J
C34	CAP, FXD, SM: 250 uuf ± 5% 500 wvdc	5910-850-9323	DM15E251J	J
C36	CAP, VAR, AIR: 11.6-202 uuf 1500 peak	5910-854-3354	167-152-9	H
	(used before Ser No. 1530)			
C36	CAP, VAR, AIR: same except oilite bearing		167-152-10	H
	(used after Ser No. 1530, interchangeable)			

*See note 1, page 23

SYMBOL	NAME & DESCRIPTION	FEDERAL STOCK NO	MFG PART NO	MFG
C38	CAP, VAR, CER: 7-45 uuf N500 500 wvdc	5910-837-0532	0503001D2P033R	L
C39, 85 87	CAP, FXD, SM: 33 uuf ± 5% 500 wvdc	5910-578-8480	DM15E330J	J
C40,42,44 46,48	CAP, VAR, CER: 4.5-25 uuf NPO 500 wvdc	5910-854-3355	0503001C0P037R	L
C41,43,45,47	CAP, FXD, CER: N80 155 uuf ± 5% 600 wvdc	5910-082-1824	TB63 151J U1G	AL
49,84b	or N80 155 uuf ± 5% 200 wvdc		0845030U1G01550J	L
C57,58,67,70	CAP, FXD, SM: 500 uuf ± 5% 500 wvdc	5910-850-9666	DM19E501J	J
C61	CAP, FXD, SM: 470 uuf ± 5% 500 wvdc	5910-087-4666	DM19E471J	J
C62,64	CAP, FXD, CER: .001 uf ±20% 600 wvdc	5910-854-3346	BB60 102M W6W	AL
	or .001 uf ±20% 500 wvdc		0831000Z5U00102M	L
C63	CAP, FXD, SM: 360 uuf ± 5% 500 wvdc	5910-850-9324	DM15E361J	J
C68	CAP, FXD, SM: 68 uuf ± 5% 500 wvdc	5910-805-1445	DM15E680J	J
C77	CAP, FXD, SM: 2000 uuf ± 5% 500 wvdc	5910-725-1029	DM19E202J	J
C80,83	CAP, VAR, AIR: 4-10 uuf 4 turn	5910-854-3353	SPEC4197	B
C81,88	CAP, VAR, CER: 5-25 uuf NPO 350 wvdc	5910-854-3356	0557006C0P039R	L
C82	CAP, FXD, SM: 15 uuf ± 5% 500 wvdc		DM15C150J	J
D1,2,3,4	SEMICONDUCTOR DEVICE, DIODE: (used before Ser No. 1631)	5960-886-4697	1N34A	P
D1,2,3,4	SEMICONDUCTOR DEVICE, DIODE: (used after Ser No. 1631, interchangeable as sets of D1-D2 or D3-D4)		1N277	V
D5	SEMICONDUCTOR DEVICE, DIODE ZENER:	5960-838-9484	1N3027	AF
DS1,2	LAMP, INCANDESCENT:	6240-155-8706	47	AJ
F1	FUSE CARTRIDGE: 1 amp	5920-538-5986	AGC1	D
J1,4*,5,6,9	CONNECTOR, receptacle, electrical: UG-657/U	5935-502-5151	31-102	AH
J3*	JACK, telephone:	5935-283-1256	12A	U
J3**	JACK, telephone:	5935-965-9864	L11	U
J7	CONNECTOR, receptacle, electrical:	5935-892-8983	160-5	AH
J8	JACK, tip: white	5935-617-6837	SKT-10	AI
L1	REACTOR, fxd ind: 7 hy	5950-854-6953	TTI-3133	W

*,** see note 2, page 23

SYMBOL	NAME & DESCRIPTION	FEDERAL STOCK NO	MFG PART NO	MFG
L2	TRANSFORMER, rf:	5950-823-3288	2360E	R
L3	TRANSFORMER, rf:	5950-854-6956	2366	R
L4	COIL, rf: 500 uh 11Ω dc res		1500-15	X
	or 500 uh 11Ω dc res (coated)		1500-12	X
L5	COIL, rf: 290 uh	5950-892-8113	3038-11	R
L6	COIL, rf: 4.7 mh	5950-082-1851	RFC-L-4700 UH	AG
LPF	FILTER, lowpass: 400 kc	5915-879-8735	3002	R
LS1	LOUDSPEAKER, pm: 200 to 8000~ ±5 db 3.2Ω	5965-892-3467	V35A47	AK
M	MULTIMETER, 0-200 ua dc, 800Ω (used before Ser No. 1377)	6625-892-4511	GD-192B	Q
M	MULTIMETER, 0-200 ua dc, 2% (used after Ser No. 1376, interchangeable after Ser No. 1376)	6625-757-9253	3005-31	R
R1a,67	RES, FXD, COMP: 680Ω ±10% 2W	5905-256-0390	RC42GF681K	MIL
R1b, 75	RES, FXD, COMP: 5600Ω ±10% ½W (R75 used after Ser No. 1376)	5905-195-6453	RC20GF562K	MIL
R2	RES, FXD, COMP: 150Ω ±10% 2W	5905-171-1975	RC42GF151K	MIL
R3,30	RES, FXD, COMP: 1500Ω ±10% ½W	5905-279-1757	RC20GF152K	MIL
R4	RES, FXD, WW: 3K ±10% 10W (used before Ser No. 1701)	5905-082-1615	1-3/4-D-54-F-3000	P
R4	RES, FXD, WW: 3.6K ±10% 10W (used after Ser No. 1700)		4837	P
R5,6,32,41 43,45,51	RES, FXD, COMP: 100K ±10% ½W	5905-195-6761	RC20GF104K	MIL
R7,8,34,36	RES, FXD, COMP: 220Ω ±10% ½W	5905-279-3513	RC20GF221K	MIL
R9	RES, FXD, COMP: 680Ω ±10% ½W	5905-195-6791	RC20GF681K	MIL
R10	RES, FXD, COMP: 18K ±10% 1W	5905-299-2023	RC32GF183K	MIL
R11	RES, VAR, COMP: A, SD, locking type 25K ±10% 2W	5905-502-8380	JA2L040S253UC	C
R12	RES, FXD, COMP: 39K ±10% ½W	5905-279-3497	RC20GF393K	MIL
R13,54	RES, FXD, COMP: 1M ±10% ½W	5905-192-0390	RC20GF105K	MIL
R17,56	RES, FXD, COMP: 820Ω ±10% ½W	5905-171-1999	RC20GF821K	MIL

PARTS LIST (Cont'd)

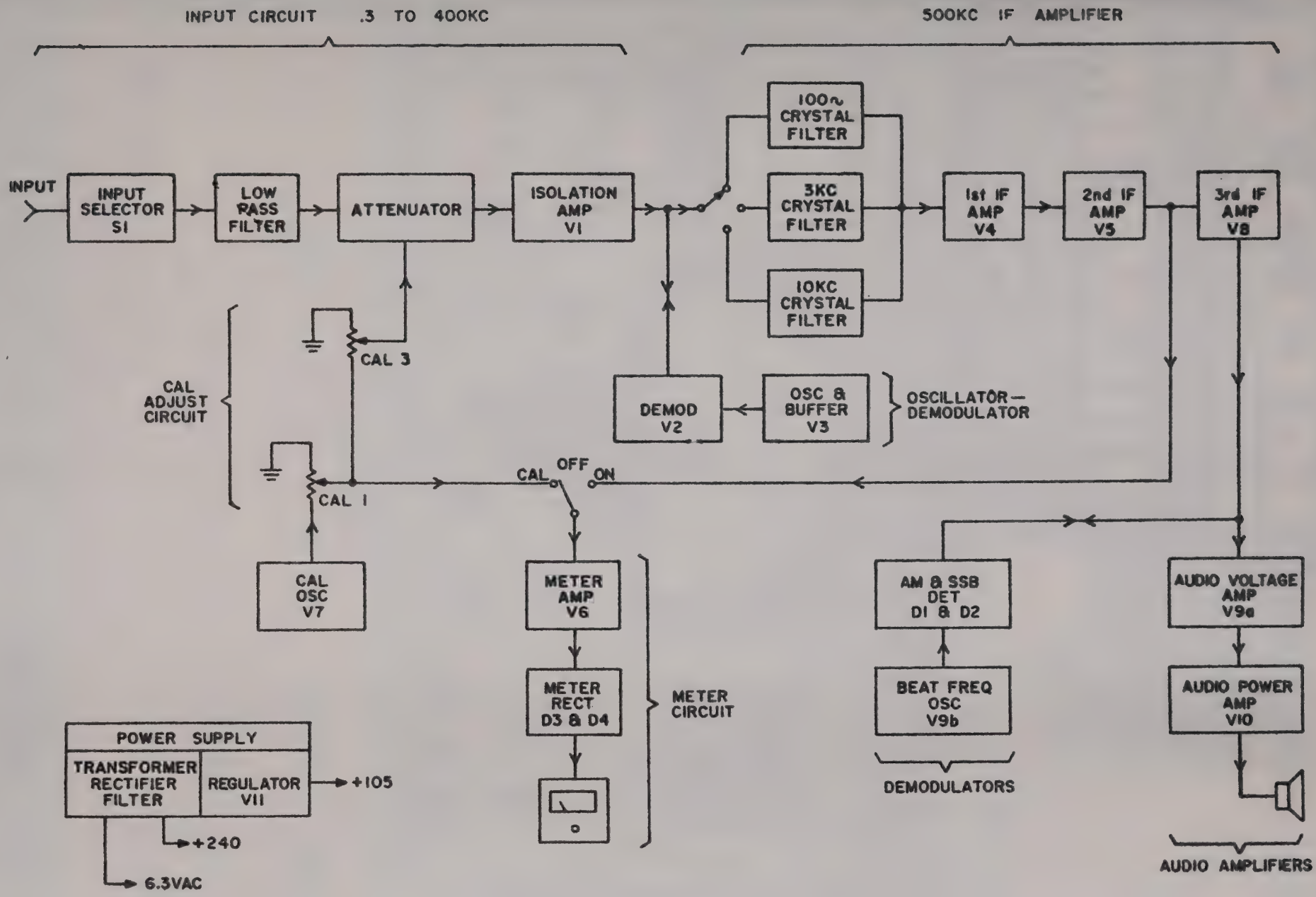
SYMBOL	NAME & DESCRIPTION	FEDERAL STOCK NO	MFG PART NO	MFG
R18,53,62	RES, FXD, COMP: 120K ±10% ½W	5905-192-3981	RC20GF124K	MIL
R19,63	RES, FXD, COMP: 47K ±10% ½W	5905-254-9201	RC20GF473K	MIL
R20,39,44,64	RES, FXD, COMP: 2K ± 5% ½W	5905-190-8887	RC20GF202J	MIL
R21,35,38 49,65,68	RES, FXD, COMP: 6.8K ±10% ½W	5905-279-3503	RC20GF682K	MIL
R22,23,29	RES, FXD, FILM: 4.99K ± 1% ½W	5905-577-0890	RN70B4991F	MIL
	or 4.99K ± 1% ½W		RN15X4991F	MIL
R24	RES, VAR, COMP: 500Ω ±30% ½W			
	A, 13/16"S, 10 turn	5905-879-6641	JF7541	F
R25	RES, VAR, COMP: 2500Ω ±30% ¼W			
	A, 1¼"S SD	5905-879-7511	JF7542	F
R31	RES, FXD, COMP: 220K ±10% ½W	5905-192-0667	RC20GF224K	MIL
R37,55	RES, VAR, COMP: 5K ±30% ½W			
	A, 3/8"S, SD	5905-879-7512	JF7539	F
R40,50,52	RES, FXD, COMP: 27K ±10% ½W	5905-279-3499	RC20GF273K	MIL
R42 (& AC OFF)	RES, VAR, COMP: 250K ±30% ¼W			
	A, 3/8"S, with SPST switch	5905-879-7513	KS9156	F
R46	RES, FXD, COMP: 820Ω ±10% 2W	5905-279-2286	RC42GF821K	MIL
R47,48	RES, FXD, COMP: 13K ± 5% ½W	5905-279-2669	RC20GF133J	MIL
R57	RES, FXD, FILM: 4.02K ± 1% ½W	5905-552-7199	RN70B4021F	MIL
	or 4.02K ± 1% ½W		RN15X4021F	MIL
R58	RES, VAR, COMP: 5K ±30% ½W			
	A, HT, SD	5905-879-7514	JF7540	F
R59	RES, FXD, FILM: 487Ω ± 1% ½W	5905-556-3340	RN70B4870F	MIL
	or 487Ω ± 1% ½W		RN15X4870F	MIL
R60	RES, FXD, FILM: 100Ω ± 1% ½W	5905-552-3893	RN70B1000F	MIL
	or 100Ω ± 1% ½W		RN15X1000F	MIL
R61	RES, FXD, COMP: 560Ω ±10% ½W	5905-195-6800	RC20GF561K	MIL
R66	RES, FXD, COMP: 68K ±10% ½W	5905-249-3661	RC20GF683K	MIL
R74	RES, FXD, COMP: 100Ω ±10% ½W		RC20GF101K	MIL
S1	SWITCH, ROTARY: 2 pole, 6 throw, 1 sect	5930-823-0946	198420-F1	AM
S2	SWITCH, ROTARY: 2 pole, 3 throw, 2 sect	5930-063-0316	227177-F2	AM
S3	SWITCH, ROTARY: 1 pole, 7 throw, 2 sect	5930-823-0915	188408-F2	AM

SYMBOL	NAME & DESCRIPTION	FEDERAL STOCK NO	MFG PART NO	MFG
S4	SWITCH, ROTARY: 4 pole, 5 throw, 2 sect	5930-971-9711	246334-F2	AM
S5	SWITCH, ROTARY: 3 pole, 3 throw, 1 sect	5930-823-0914	177290-F1	AM
S6	SWITCH, TOGGLE: dpdt	5930-846-0428	81027-CH	AA
SR1	RECTIFIER, METALLIC: single phase bridge type (used before Ser No. 1701)	6130-873-4468	61-4037	N
SR1	RECTIFIER, SILICON BRDG ASSY (used after Ser No. 1700, interchangeable)		3055-1	R
	DIODES only for above assy		SM-180	AO
T1,2,3, 4,5,6	TRANSFORMER, IF: 500 KC, slug tuned	5950-875-9332	R8260	T
T8*	TRANSFORMER, OUTPUT: 600Ω sec tapped at 3.2Ω	5950-854-3361	TTI-3134	W
T8**	TRANSFORMER, OUTPUT: as above with added CT		TTI-7720	W
T9	TRANSFORMER, PWR: 115V pri, 230, 6.3V sec (used on units for 115V AC power source)	5950-854-6954	TTI-3135	W
T9	TRANSFORMER, PWR: 230V pri, 230, 6.3V sec (used on units for 230V AC power source)	5950-082-1853	TTI-7133	W
TB1**	BLOCK, TERMINAL:		600-Y-4	AE
--**	JUMPER, ELECTRICAL: for TB1		600-J	AE
Vc1,2	SEMICONDUCTOR DEVICE, CAPACITOR DIODE: (used before Ser No. 1345)	5960-087-4672	1N953	AD
Vc1,2	SEMICONDUCTOR DEVICE, CAPACITOR DIODE: (used after Ser No. 1345, use this for replacement in all units)		1N952	AD
V1,4,6,8	ELECTRON TUBE:	5960-854-3362	6661/6BH6	
V2	ELECTRON TUBE:	5960-188-3544	6AL5	
V3,7,9	ELECTRON TUBE:	5960-166-7663	12AU7	
V5	ELECTRON TUBE:	5960-188-6589	6BJ6	
V10	ELECTRON TUBE:	5960-166-7673	6AQ5	
V11	ELECTRON TUBE:	5960-166-7648	OB2	
X1*,3*	CRYSTAL UNIT, QUARTZ: 499,935~, ±.02%-40 to +70°C	5955-892-3436	103K	O
X1**,X3**	CRYSTAL UNIT, QUARTZ: 499,955~, ±.02%-40 to +70°C	5955-053-5404	155K	O

*,** see note 2, page 23

SYMBOL	NAME & DESCRIPTION	FEDERAL STOCK NO	MFG PART NO	MFG
X2*,X4*	CRYSTAL UNIT, QUARTZ: 500,065~, ±.02%-40 to +70°C	5955-892-3437	104K	0
X2**,X4**	CRYSTAL UNIT, QUARTZ: 500,045~, ±.02%-40 to +70°C	5955-053-5405	156K	0
X5,X8	CRYSTAL UNIT, QUARTZ: 498,530~, ±.02%-40 to +70°C	5955-087-4670	147K	0
X6,X7	CRYSTAL UNIT, QUARTZ: 501,470~, ±.02%-40 to +70°C	5955-087-4671	148K	0
X9	CRYSTAL UNIT, QUARTZ: 498,530~, ±.02%-40 to +70°C	5955-892-3440	107K	0
X10	CRYSTAL UNIT, QUARTZ: 501,470~, ±.02%-40 to +70°C	5955-892-3441	108K	0
X11	CRYSTAL UNIT, QUARTZ: 504,750~, ±.02%-40 to +70°C	5955-063-2584	149K	0
X12	CRYSTAL UNIT, QUARTZ: 505,500~, ±.02%-40 to +70°C	5955-063-2585	150K	0
XF1	FUSEHOLDER	5920-280-8338	HKP	D

*,** see note 2, page 23



BLOCK DIAGRAM
2174A

RYCOM® INSTRUMENTS

FREQUENCY SELECTIVE VOLTMETER

WAVE ANALYZER

DIRECT READING IN dbm FOR 135-600 ohm OR BRIDGING CIRCUITS

MODEL 2174A

SPECIFICATIONS					
MODEL	**FREQUENCY RANGE**	**SELECTIVITY**	**LEVEL FULL SCALE**	**ACCURACY**	**TYPICAL FILTER SELECTIVITY**
2171A	60 Cycles to 6 Kilocycles	30 Cycle or 50 Cycle Filter	−68 to +32dbm	± .5db −80 to +32dbm 300 Cycles to 4 Kilocycles	30 **CYCLE FILTER** 6db— 35 Cycles 60db—250 Cycles
2174A	300 Cycles to 400 Kilocycles	50 Cycle or 100 Cycle Filter *	−68 to +32dbm	± .5db −80 to +32 dbm. 300 to 400 Kilocycles	50 **CYCLE FILTER** 6db— 60 Cycles 60db—450 Cycles
SPURIOUS RESPONSE: Below 60db LOW INTERMODULATION: Below 60db POWER REQUIREMENTS: 115 V. A.C.—50/60 Cycles. WEIGHT: 28 lbs.					100 **CYCLE FILTER** 6db—140 Cycles 60db—900 Cycles
* Including a wider filter and demodulator for monitoring SSB, AM and FM signals.					

A highly selective measuring instrument, utilizing the heterodyne principle with balanced modulation, offers fast and accurate means of making amplitude measurements. High resolution is achieved by means of highly selective crystal filters, with a 50 or 100 cycle filter available for amplitude measurements.*A 3 kilocycle filter with demodulator is provided for monitoring of SSB speech or tone signals.

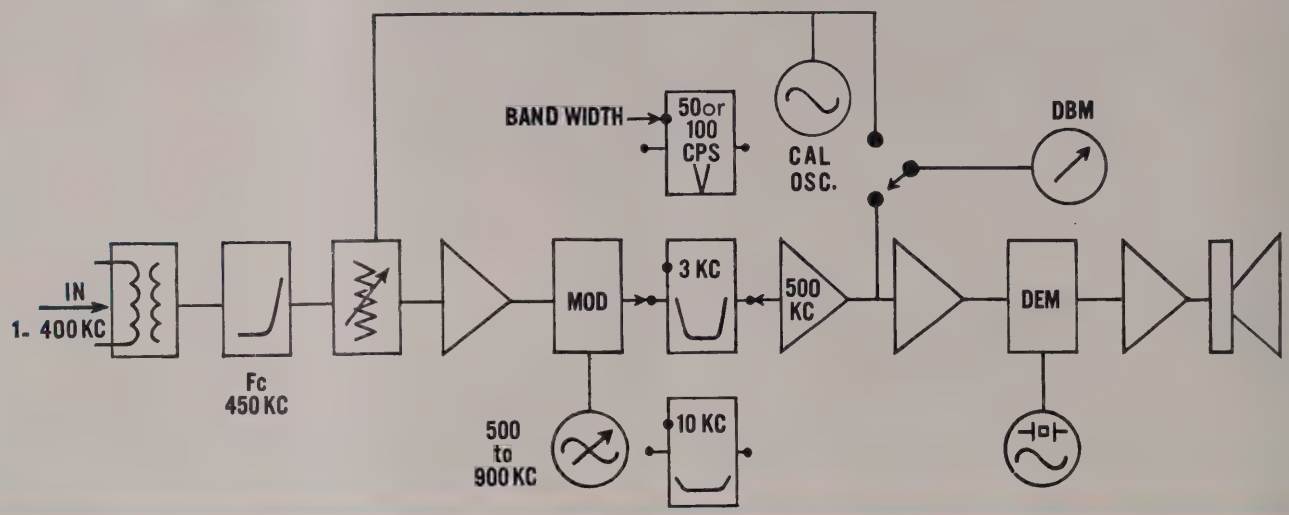
RYCOM® INSTRUMENTS

A Division of

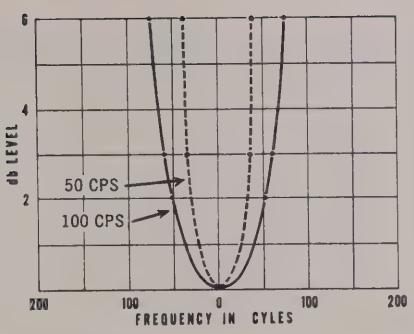
RAILWAY COMMUNICATIONS, INC.

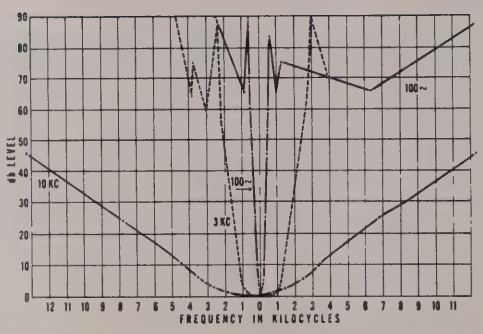
9351 East 59th Street Raytown, Missouri

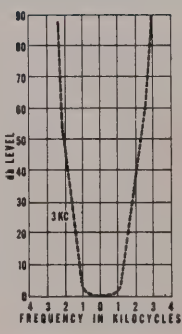
MODEL 2174A FUNCTIONAL BLOCK DESIGN

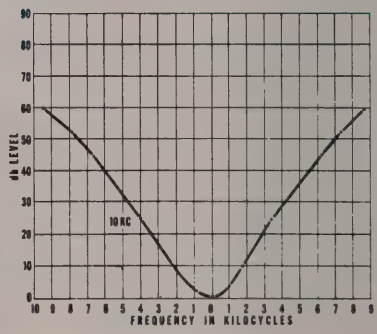


FILTER RESPONSE CURVES . . . MODEL 2174A









*Bandwidth

50 CYCLE FILTER
6db — 60 Cycles
60db — 450 Cycles

100 CYCLE FILTER
6db — 140 Cycles
60db — 900 Cycles

3KC FILTER
3db — 2140 Cycles
45db — 4200 Cycles

10KC FILTER
3db — 4460 Cycles
45db — 24,950 Cycles

*Average Measure

Submit your requirements for special deviations from above instruments

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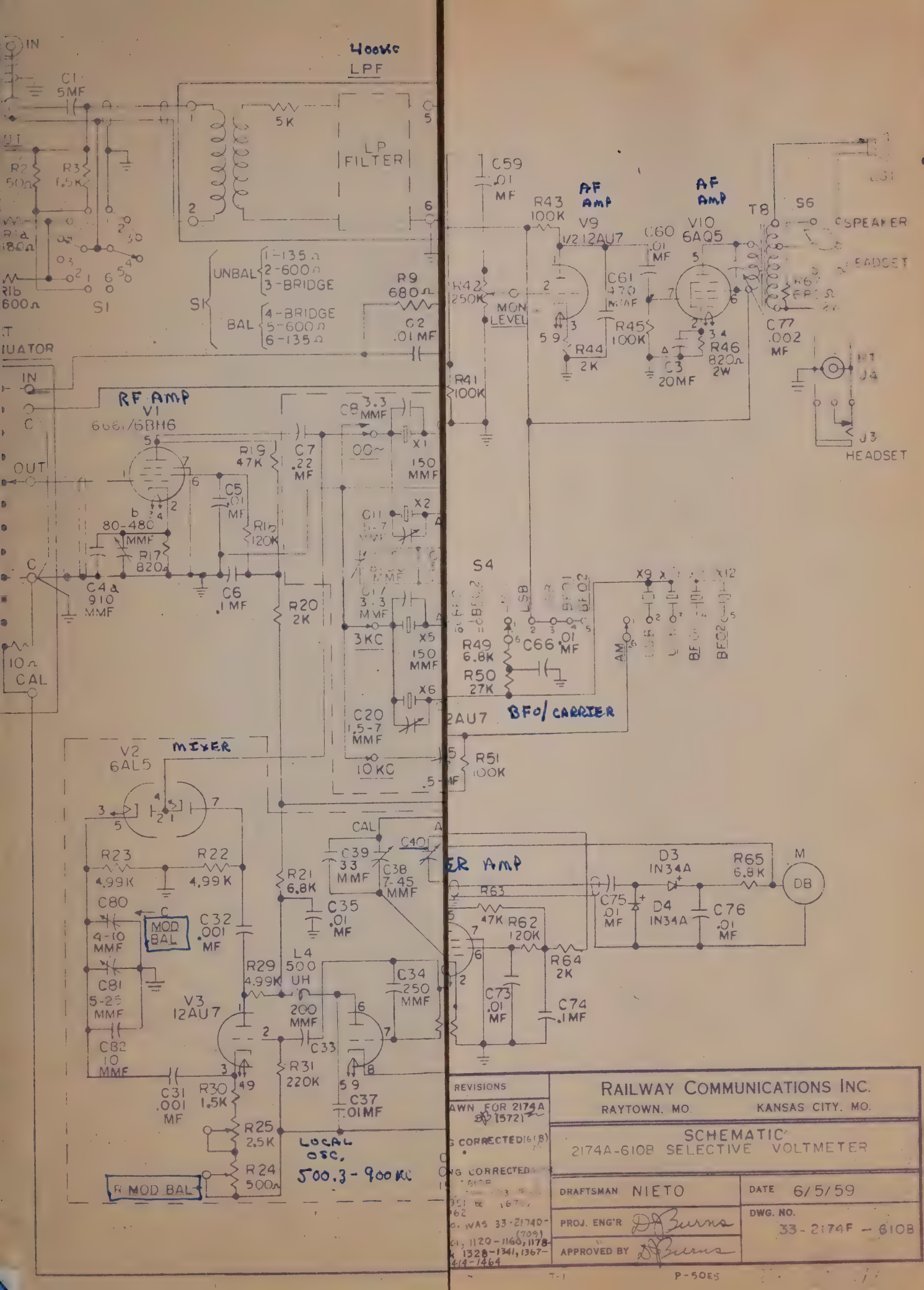
A Division of

RAILWAY COMMUNICATIONS, INC.

9351 E. 59TH STREET, RAYTOWN, MISSOURI

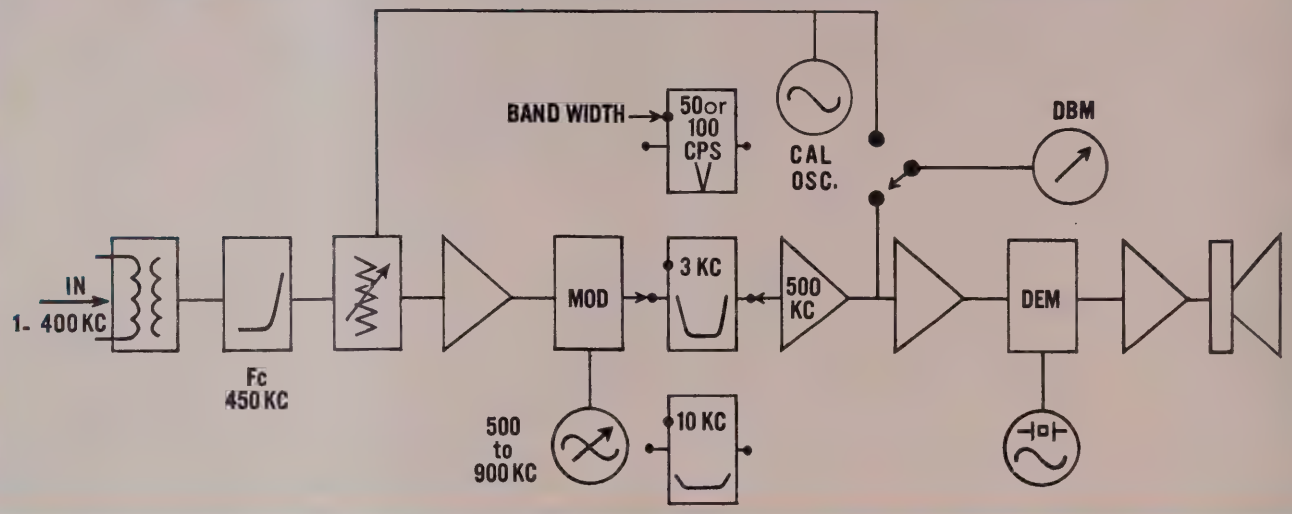
Phone: Code #816—FLeming 3-2100



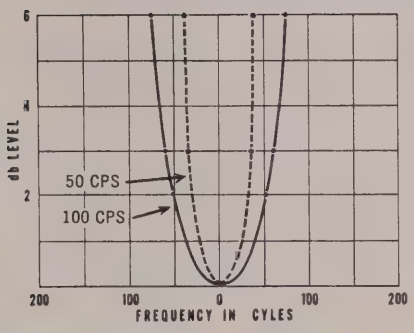
REVISIONS	RAILWAY COMMUNICATIONS INC. RAYTOWN, MO. KANSAS CITY, MO.	
AWN FOR 2174A [5721]	SCHEMATIC 2174A-610B SELECTIVE VOLTMETER	
G CORRECTED (6)(8)		
NG CORRECTED		
o. WAS 33-21740- (709)	DRAFTSMAN NIETO	DATE 6/5/59
61, 1120-1160, 1178- 1328-1341, 1367- 1414-1464	PROJ. ENG'R D F Burns	DWG. NO. 33-2174F-610B
	APPROVED BY D F Burns	

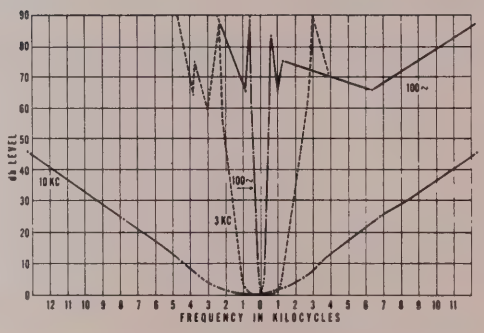
T-1 P-5065

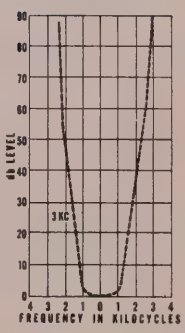
MODEL 2174A FUNCTIONAL BLOCK DESIGN

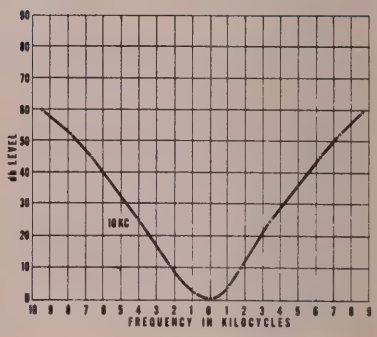


FILTER RESPONSE CURVES . . . MODEL 2174A









*Bandwidth

50 CYCLE FILTER
- 6db — 60 Cycles
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100 CYCLE FILTER
- 6db — 140 Cycles
- 60db — 900 Cycles

3KC FILTER
- 3db — 2140 Cycles
- 45db — 4200 Cycles

10KC FILTER
- 3db — 4460 Cycles
- 45db — 24,950 Cycles

*Average Measure

Submit your requirements for special deviations from above instruments

RYCOM® INSTRUMENTS

A Division of

RAILWAY COMMUNICATIONS, INC.

9351 E. 59TH STREET, RAYTOWN, MISSOURI

Phone: Code #816—FLeming 3-2100

Hooke LPF

IN
C1 5MF
INPUT
R2 150Ω
R3 1.5K
R1a 680Ω
R1b 5600Ω
ATTENUATOR
S1
5K
LP FILTER
SK
UNBAL 1-135Ω 2-600Ω 3-BRIDGE
BAL 4-BRIDGE 5-600Ω 6-135Ω
R9 680Ω
C2 .01 MF
R10 18K 1W
V11 0B2
C78 .1MF
D5 IN3027
R11 25K
R12 39K
R13 1M
J8
J9
S2
SELECTIVITY
R4 3K
L1 7HY
40MF EACH
C3.
SR1
T9
AC. OFF
F1 1A
J7 AC
A.C.
R5 100K
R6 100K
R7 220Ω
C9 .1MF .1MF
R8 220Ω
C10
DS1
DS2
FILAMENTS

RF AMP
V1 6661/6BH6
C4a 910 MMF
C5 .01 MF
C6 .1 MF
R17 820Ω
80-480 MMF
R19 47K
C7 .22 MF
R18 120K
R20 2K
10Ω CAL
C8 3.3 MMF
C11 1.5-7 MMF
C17 3.3 MMF
C19 8-50 MMF
C20 1.5-7 MMF
C12 3.3 MMF
C16 8-50 MMF
C15 1.5-7 MMF
C21 3.3 MMF
C25 6-50 MMF
C24 1.5-7 MMF
C26 .5-5 MMF
C29 47 MMF
T1
T2
X1 X2 X3 X4 X5 X6 X7 X8
150 MMF
100Ω
3KC
10KC
A1 #3014 CRYSTAL FILTER ASSY.

V2 6AL5 MIXER
R23 4.99K
R22 4.99K
C80 4-10 MMF
MOD BAL
C32 .001 MF
C81 5-25 MMF
C82 10 MMF
C31 .001 MF
R30 1.5K
R25 2.5K
R24 500Ω
R MOD BAL
R21 6.8K
C35 .01 MF
C39 33 MMF
C38 7-45 MMF
C40 C41 C42 C43 C44 C45 C46 C47 C48 C49
ROTOR
CAL
R29 4.99K
V3 12AU7
L4 500 UH
200 MMF
C33
C34 250 MMF
R31 220K
C37 .01MF
R32 100K
L3
CAL 2 TRIM
C83 4-10 MMF
C84a 33 MMF
C84b 155 MMF
C85 33 MMF
C86 .001MF
C88 5-25 MMF
Vc1 Vc2
1N953
L6 4.7MH
LOCAL OSC. 500.3 - 900 KC
A2 (OSC ASSY #3019)
CAPACITORS A,B,C,D,E COMP'D OF 4.5-25MMF CERAMIC TRIMMER & 155 MMF CAPACITORS
S3 (CAL POS.) BAND SWITCH
C36 11.6-202MMF MAIN TUNING

500KC IF
V4 6BH6
T3
T4
C50 .01 MF
C51 .01 MF
R34 220Ω
500KC IF
V5 6BJ6
T5
C52 .01 MF
C53 .01 MF
C54 .01 MF
R36 220Ω
R37 5K
CAL 2 LEV (IF GAIN)
R35 6.8K
R38 6.8K
C55 .1MF
IF AMP
V8 6BH6
T6
R66 68K
C56 .01 MF
R39 2K
R40 27K
C57 C58
500 MMF
R41 100K
D1 1N34A
D2 1N34A
R47 13K
R48 13K
C64 .001 MF
C62 .001 MF
C63 360 MMF
V9 1/2 12AU7
BFO/CARRIER
C65 47 MMF
R51 100K
R52 27K
R49 6.8K
R50 27K
C66 .01 MF
S4
AM LSB USB BFO1 BFO2
X9 X10 X11 X12

AF AMP
V9 1/2 12AU7
C59 .01 MF
R43 100K
R42 250K
MON LEVEL
C60 .01 MF
C61 470 MMF
R45 100K
R44 2K
C3 20MF
AF AMP
V10 6AQ5
R46 820Ω 2W
T8
S6
SPEAKER
HEADSET
LS1
N67 68Ω 2W
C77 .002 MF
HT
J4
J3 HEADSET

CATH FOLL
V7 12AU7
C67 500 MMF
C68 68 MMF
C69 910 MMF
C70 500 MMF
R53 120KΩ
R54 1M
L2
C71 .1 MF
R55 5K
CAL 1 LEV ADJ CAL OSC 30KC
R56 820
CAL OSC
C72 .01 MF
CAL 1
R57 4.02K
CAL 3
R58 5K
R59 487Ω
R60 100Ω
S5
OFF
ON CAL 1
METER
OFF ON

METER AMP
V6 6BH6
R63 47K
R62 120K
R64 2K
C73 .01 MF
C74 .1MF
R61 560Ω
J5 IF
D3 IN34A
D4 IN34A
C75 .01 MF
C76 .01 MF
R65 6.8K
M DB

NO.	DATE	REVISIONS
B	6/5 59	REDRAWN FOR 2174A (5721)
C	4-61	TRACING CORRECTED (6181)
D	10-61	TRACING CORRECTED (6181)
-	4-62	IT FOR 6108 SEQ. NOS. 798-803 & 861-951 & (670) 956-962
F	1-63	DWG. NO. WAS 33-21740-6108.
	5-63	1045-1101, 1120-1160, 1178-1293 & 1328-1341, 1367-1376, 1414-1464 (709)

RAILWAY COMMUNICATIONS INC.
RAYTOWN, MO. KANSAS CITY, MO.

SCHEMATIC
2174A-6108 SELECTIVE VOLTMETER

DRAFTSMAN NIETO
DATE 6/5/59
PROJ. ENG'R D.A. Burns
APPROVED BY D.A. Burns
DWG. NO. 33-2174F - 6108